REMARKS

Reconsideration of the November 20, 2003 Official action is respectfully requested. Claims 1, 2, 4-7, 9, 11-17 and 20-23 are pending in the application for the Examiner's review and consideration.

By this Amendment, Claim 10 has been canceled and Claim 1 has been amended to incorporate the subject matter of canceled Claim 10. Specifically, the plasma reactor of Claim 1 is now defined as "a dual frequency parallel plate plasma reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency." Reconsideration of the November 20, 2003 Official Action is respectfully requested.

First Rejection

Claims 1, 2, 4-7, 9, 11-16 and 19-22 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over U.S. Patent No. 5,786,276 to Brooks et al. ("Brooks") in view of U.S. Patent No. 6,263,109 to Kim et al. ("Kim"). The reasons for the rejection are set forth in numbered paragraph 5, on pages 2-7 of the Official Action. This rejection is now moot in view of the incorporation of the subject matter of Claim 10 into Claim 1.

Second Rejection

Claims 10 and 23 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Brooks and Kim in further view of U.S. Patent No. 6,355,573 to Okumura et al. ("Okumura"). The reasons for the rejection are set forth in numbered paragraph 6, on

pages 7-8 of the Official Action. The Official Action alleges that Okumura discloses a method to perform a plasma etching reactor having a showerhead electrode and bottom electrode on which a substrate is supported, the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency. Claim 10 has been canceled, but Claim 1 has been amended to incorporate the subject matter of Claim 10. This rejection is respectfully traversed.

1 - Legal Standard for § 103 Rejection

Reconsideration of the rejection is requested in view of the following legal precedent regarding rejections based on a combination of prior art references.

According to MPEP § 2143, to establish a prima facie case of obviousness, (1) "there must be some suggestion or motivation, either in references themselves or in the knowledge generally available to one of ordinary skill in the art, to ... combine reference teachings"; (2) "there must be a reasonable expectation of success"; and (3) "the prior art ... references when combined ... must teach or suggest all the claim limitations". The Patent Office has the initial burden of establishing each of these requirements of a prima facie case of obviousness. In re Piasecki, 223 USPQ 785, 787 (Fed. Cir. 1984) and In re Warner, 154 USPQ 173 (CCPA 1967).

If the proposed modification or combination of the prior art would change the principle of operation of the prior invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

Additionally, if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984).

2 - Claimed Subject Matter

As amended, Claim 1 sets forth a process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, comprising introducing a semiconductor substrate into a medium density plasma etching reactor, wherein the plasma reactor comprises a dual frequency parallel plate plasma reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency, the semiconductor substrate having a layer of silicon nitride and the layer of silicon nitride having an underlying and/or overlying dielectric layer; supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including CH_3F and at least one oxygen reactant supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to CH_3F of 0.65 to 1.5; etching exposed portions of the silicon nitride layer with the plasma so as to etch openings in the silicon nitride layer with the plasma while providing an etch rate selectivity of the etching rate of the silicon nitride layer to the etching rate of the dielectric layer of at least about 10.

As set forth below, the combinations of features recited in Claim 1 and in the claims dependent thereon are not suggested by the combination of Brooks, Kim and Okumura.

3 - The Combination of Brooks, Kim, and Okumura

Do Not Render the Present Invention Obvious

In the Official Action, Brooks is cited for a disclosure of a method of plasma etching a silicon nitride layer using an etching gas including CH_3F and at least one oxygen reactant supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to CH_3F within the range of 0.65 to 1.5; and etching exposed portions of the silicon nitride layer with the plasma so as to etch openings in the silicon nitride layer with the plasma while providing an etch rate selectivity of the etching rate of a silicon nitride layer to the etching rate of the dielectric layer of at least about 50 (paragraph bridging pages 2-3 of Official Action). However, as explained below, Brooks relates to chemical downstream etching (Column 4, lines 11-18 and line 57 thru Column 5, line 5), wherein plasma is formed upstream of a gas distribution plate 140 (Column 7, lines 60-63). In Brooks, the plasma travels into the etch chamber by passing through the plate 140. The Brooks arrangement does not include a showerhead electrode and thus teaches away from carrying out the Brooks process in a medium density parallel plate plasma reactor.

Brooks discloses a process wherein the plasma is not formed in the etch chamber. Rather, the plasma in Brooks is created remotely from the etching chamber and then a downstream output (afterglow) of the plasma is applied to the wafer for etching (see column 2, lines 60-64). Accordingly, the Brooks process is completely different from a process wherein plasma is formed within the etch chamber.

Because Brooks forms the plasma upstream of the gas distribution plate, it would not have been obvious to one of ordinary skill in the art to replace the Brooks plasma etch reactor with a dual frequency parallel plate reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency.

While Brooks discloses a process wherein the plasma is formed outside the etch chamber, the Official Action cites Kim for disclosure of a conventional capacitively coupled medium density plasma reactor, alleging that it would have been obvious to use Kim to modify Brooks to reach the present invention. However, Kim applies to a completely different etch process than is disclosed in Brooks. In particular, Kim discloses a "single-step plasma etching process *for etching both oxide and nitride* with selectivity to photoresist and silicon." See abstract (emphasis added). Brooks, on the other hand, forms a remote (afterglow) plasma using "chemical downstream etching (CDE) that is selective to silicon nitrides (SiN) over silicon oxides (SiO)..." See abstract. As such, Brooks and Kim use different types of plasma etch reactors to carry out different etching processes. Nothing short of impermissible hindsight would lead one of ordinary skill in the art to use the Kim etch reactor in the process of Brooks. Moreover, the plasma reactor of Kim would be unsuitable for Brooks's plasma etch process because it would change the principle of operation of Brooks to use a medium density etch reactor to carry out Brooks's etch process. Accordingly, because the proposed modification to Brooks would change the

principle of operation of Brooks, the teachings of Brooks and Kim are not sufficient to render the claims *prima facie* obvious. See In re Ratti, 123 USPQ 349 (CCPA 1959).

Additionally, as stated above, Kim discloses a "single-step plasma etching process *for etching both oxide and nitride* with selectivity to photoresist and silicon." See abstract (emphasis added). In contrast, Claim 1 is directed to a process of etching silicon nitride with an etch rate selectivity of silicon nitride to dielectric of at least 10. Kim seeks a contrary result, *i.e.*, to "*reduce the selectivity to nitride*, permitting a one-step oxide/nitride etch." Column 4, lines 52-53 (emphasis added). In fact, Kim reports an etch rate selectivity of 1.5 and thus *teaches away* from a selectivity of more than 10 (See column 5, lines 22-26). In a process of Kim, a fluorocarbon gas and an oxygen-containing gas are used to etch oxide and nitride where "the nitride is etched through somewhat *slower* than the oxide" Table I and column 5, lines 20-26. Furthermore, Kim discloses that the combination of CH_2F_2 (a hydrofluorocarbon) and CO (an oxygen-containing gas) can be used to "*reduce the selectivity to nitride*, permitting a one-step oxide/nitride etch." Column 4, lines 53-54 (emphasis added). Thus, the combination of Brooks and Kim would not lead to a process for *etching a silicon nitride layer* with selectivity to an underlying and/or overlying dielectric layer in a medium density plasma as required by Claim 1. The addition of Kim destroys the principle of operation of the process according to the invention of Brooks. Accordingly, because the proposed modification to Brooks would change the principle of operation of Brooks, the teachings of Brooks and Kim are not sufficient to render the claims prima facie obvious. See In re Ratti, 123 USPQ 349 (CCPA 1959). Additionally, the proposed modification to Brooks, using the etch with low

selectivity to nitride of Kim, renders Brooks unsatisfactory for its intended purpose. Thus, there is no suggestion or motivation to make the proposed modification. See In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984).

Further, Applicants respectfully submit that the deficiencies of Brooks and Kim noted above are not remedied by Okumura. Amended Claim 1 recites that the plasma reactor comprises a dual frequency parallel plate plasma reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency.

In contrast, Okumura seeks to deliver high-frequency power to an antenna as the top electrode and only mentions that the substrate-electrode can use high-frequency power so that ion energy that reaches the substrate can be controlled (see column 7, lines 6-10). Thus, Okumura does not provide any suggestion to carry out the process in a plasma reactor where the bottom electrode is supplied RF energy at two different frequencies. Also, Okumura does not teach that the bottom electrode could be supplied RF energy at a frequency greater than the showerhead frequency.

The absence of any teaching in Okumura of supplying the bottom electrode with dual frequencies or supplying the bottom electrode with a greater frequency than the top electrode clearly establishes that the claimed invention is patentable over the applied references.

Third Rejection

Claims 17 was rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Brooks and Kim in further view of Applicants Admitted Prior Art. The reasons for the rejection are set forth in numbered paragraph 7, on page 9 of the Official Action. This rejection is now moot in view of the incorporation of the subject matter of Claim 10 into Claim 1.

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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